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GENERAL TEST PLAN RESEARCH AND DEVELOPMENT FOR PROJECT APOLLO SPACECRAFT

NAS9-150

Volume IV. Acceptance Test Plan

Reissued 30 June 1963

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Apollo

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RESEARCH AND DEVELOPMENT FOR
PROJECT APOLLO SPACECRAFT

NAS9-150

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Exhibit I, Paragraph 3.3

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

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INTRODUCTION

Because the Apollo program is a high-reliability effort, and the constraints make a detailed, extensive reliability demonstration program impractical, a vigorous and achievable effort will be incorporated in the development, qualification, and acceptance test areas. Emphasis will be placed on acceptance (supplier and S&ID) because a properly planned acceptance test program will maintain the design intent and will prevent the high reliability of qualified units from being degraded during the production process. This is accomplished by designing the tests to assure acceptable distribution of tolerances. It must be emphasized that in order to be effective, any analysis of the acceptance data must include data accumulated during various "in-process" production tests.

1.0 SCOPE

This volume presents the acceptance test program as it is to be applied to the Apollo spacecraft subsystems and their associated ground support equipment (GSE). This volume was generated to delineate the basis for the acceptance test program and to present the philosophy of application. Subsequent revisions will present a more complete picture of the program from the point of view of concept and its application to any subsystem or relevant level of assembly.

Acceptance testing, as presented in this volume, will be performed, where practical, at the supplier's facility immediately upon completion of the in-process tests. At the S&ID facilities, receiving and/or system checkout will be accomplished only when no comprehensive and acceptable tests are accomplished prior to receipt by S&ID, or when equipment operation may be degraded by transportation, handling, or storage. The equipment test flow chart, relevant to acceptance tests, is presented in Figure 1-1. For a discussion of ground qualification tests, see Volume III of the General Test Plan.

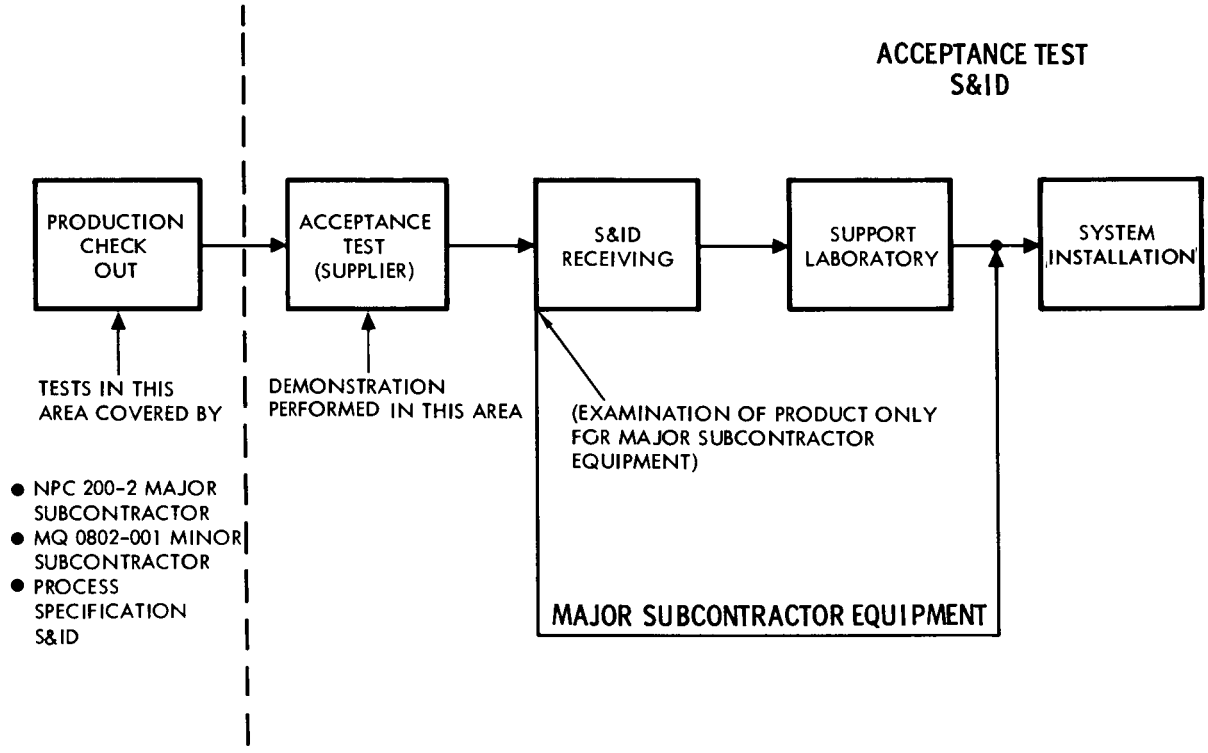

Figure 1-1. Equipment Test Flow Chart

2.0 CONCEPT

2.1 GENERAL

The acceptance test program is based on the premise that rigorous control and limitation of all measurable quantities that affect system performance by the introduction of variances about some mean (usually the absolute desired value of the parameter) can make possible the attainment of a reliability approaching the inherent reliability of the product. In order to understand this concept and to establish the validity of the premise, it is necessary to understand the physics of failure as it is affected and controlled by a screening process such as planned for Apollo acceptance testing.

It must be emphasized that this is not the "normal" acceptance test program where an end product is evaluated on its own merits with no consideration given to relevant prior data. Rather, this program requires an evaluation of prior data gathered at different stages of the production process, plus an extensive test program designed to evaluate the end product's functional capabilities in a nonprejudicial environment. A final engineering decision is required on the merits and potential reliability of a given component on an individual basis.

2.2 PREMISE

It is obvious that as the distribution of stress approaches the distribution of strength the probability of failure increases (see Figure 2-1). It is less obvious that as the distribution of strengths about a given mean increases the probability of failure (strength 2) increases. If the foregoing follows, steps must be taken to compensate and control this potentiality. S&ID proposes to do this during the Apollo Program. It is Apollo Engineering's basic responsibility to incorporate an adequate margin between stress and strength in its designs. Further discussion is contained in Volume III of the General Test Plan. It is also Engineering's responsibility to describe tolerances for parameter variation. The analysis and control of the parameter variations can be accomplished only by the acceptance test program. The tolerances for parameter variation are delineated in the respective operational test procedures and the procurement specifications for each system and its components.

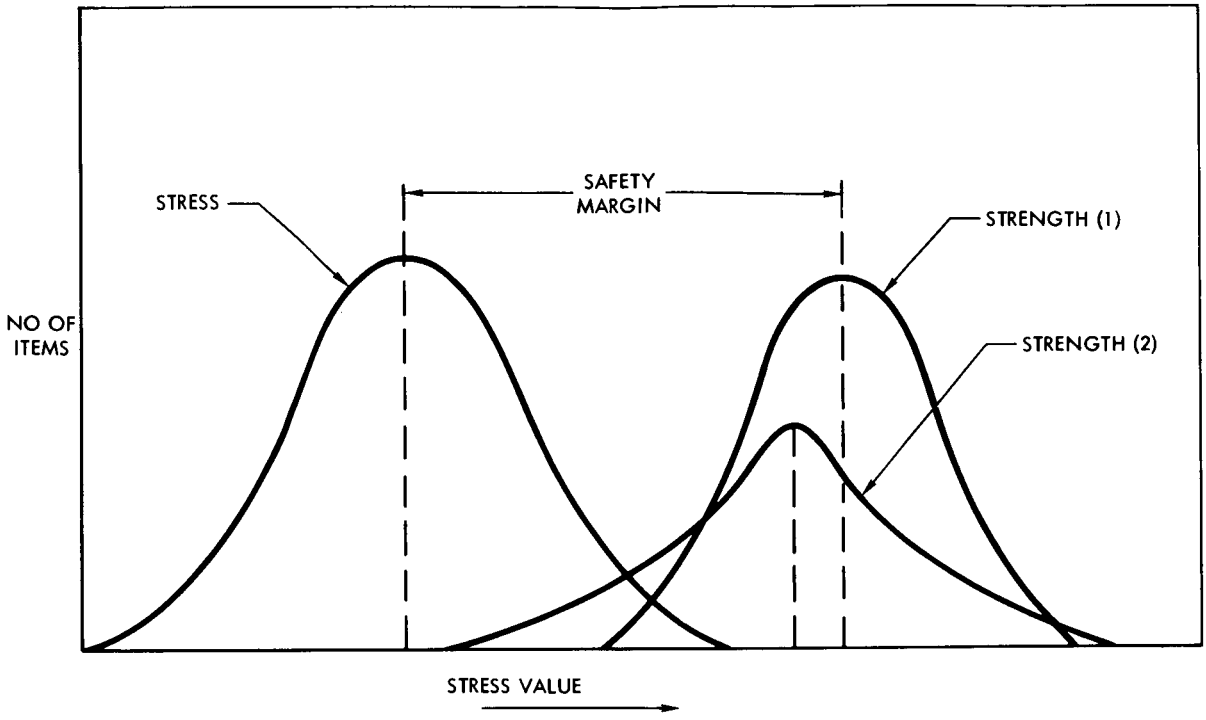

Figure 2-1. Stress-Strength Function

2.3 IMPLEMENTATION

Supplier acceptance tests will be monitored by S&ID Quality Assurance personnel or their representatives. Data obtained during these tests (successful or not) will be carefully monitored and assessed by an Apollo Engineering representative. Acceptance tests will include functional, vibration, and special nondestructive tests as delineated in pertinent specifications to eliminate poor workmanship and excessive parameter variation. The criteria for acceptance will consider past history, the in-process data that has been transmitted with the unit from the production area, and the data obtained during the acceptance test. If a unit is marginal in any of the applied tests, a review of all in-process data is required to determine the specific area where corrective action will be required. These same acceptance tests will also be performed on units that are to be subjected to qualification tests to evaluate the effectiveness of the acceptance procedure and to reject poor equipment. The rejection of units after assignment to internal or commercial test laboratories will present problems in logistics and time.

S&ID will conduct or grant a waiver on receiving acceptance tests on spacecraft parts. Acceptance tests will be performed either at the receiving area, or in a test laboratory which supports the receiving area and has the complex equipment required for checkout, in the system checkout area after the unit

has been installed as a subsystem in the spacecraft, or in an acceptance test area (for equipment fabricated in-house). The S&ID tests on equipment obtained from suppliers must be compatible with the tests performed by the suppliers at their facility. Compatibility will be assured by S&ID approval or by furnishing the supplier with test procedures.

Equipment parameters monitored and recorded during the acceptance tests are assumed to be distributed normally. Also, field stresses, such as time and wear, are assumed to cause a normal distribution of these same parameters. These are shown in Figure 2-2 (curves A and B).

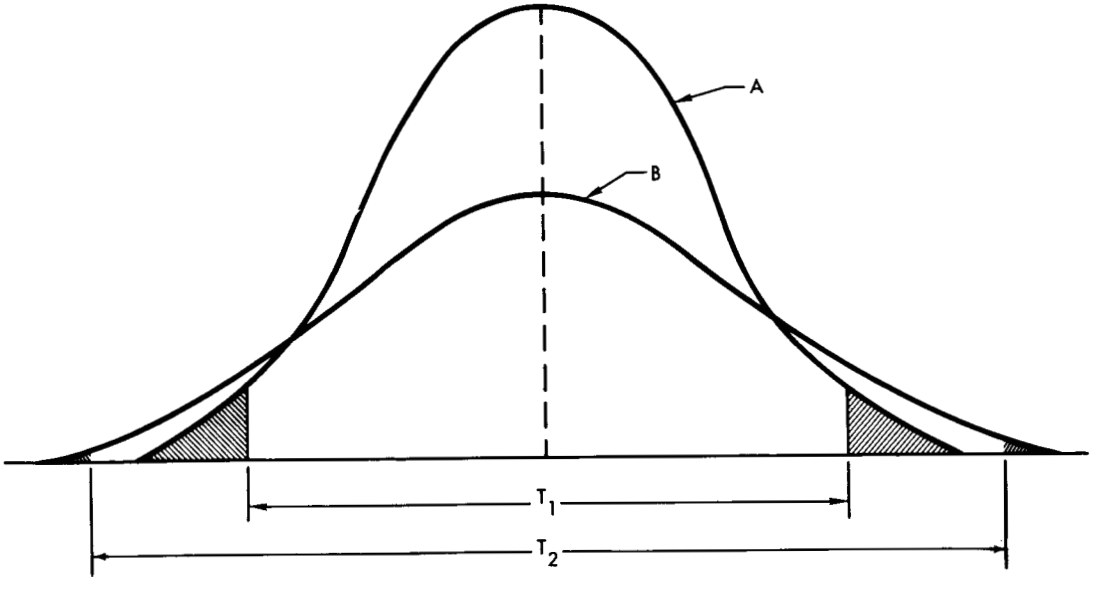

Figure 2-2. Parameter Distribution

T1 is a tolerance limit set for acceptance or rejection during the acceptance test. T2 is the maximum tolerance limit to which the equipment can be expected to degrade in the field without causing an unacceptable increase in the probability of failure of the system. Any variation of the standard deviation of curve A will be reflected directly in a change of the standard deviation of curve B. From this it can be seen that in the controlled acceptance test program planned for Apollo, any drift in the standard deviation of curve A should be anticipated, controlled, and limited. The effect of this program will be to minimize the probability of mission failures. This control of the probability of mission failures is the intent of the acceptance test program as described in this volume.

3.0 TECHNIQUES

The techniques used in performing acceptance tests will include, but not be limited to, visual inspection, functional tests (mechanical, electrical, or electro-mechanical), vibration, X-ray, infra-red, ultrasonics, and magnaflux.

3.1 VISUAL INSPECTION

These tests will verify that the materials, construction, markings, and workmanship comply with the requirements of the procurement specification.

3.2 FUNCTIONAL TESTS

These tests will demonstrate satisfactory compliance with the mechanical, electrical, or electromechanical performance requirements delineated in the procurement specification. The tests, unless otherwise specified, will be performed at normal room ambient conditions.

3.3 VIBRATION

3.3.1 Concept

The vibration test required for acceptance is a check on production techniques, not a qualification test. For this reason, the level and time were selected to reveal manufacturing faults such as loose nuts, bolts and wire, poor solder or crimp connections or missing bolts, etc., and to prevent appreciable fatigue to the equipment compared to that encountered in the qualification tests or anticipated during actual flight.

3.3.2 Application

The units will be subjected to a sinusoidal vibration test for a period of time not less than 5 minutes or the time required for a complete functional test, whichever is greater. The frequency band-width and vibration level will be 10 to 500 cps and 2 g rms respectively. The sinusoidal sweep will begin at 10 cps, increase to 500 cps and sweep back to 10 cps. The functional checkout during this test will be as complete as possible to determine proper operation. The unit under test will be monitored carefully for possible intermittent or noisy operation. There may be a requirement for additional

environmental acceptance tests such as temperature. The additional environmental tests will be governed by the sensitivity of the equipment to the environment and the proximity of the unit's design concept to the existing state-of-the-art.

3.4 SPECIAL TECHNIQUES

3.4.1 General

Recent developments in the area of acceptance testing as applied particularly to in-process testing have resulted in special tests to determine previously nondiscernible parameter variations. It is particularly important on the Apollo Project to be able to limit the variations in any given parameter to within narrow tolerances.

One of the most important new techniques employs infrared sensors that can discern a temperature differential of approximately 1,000th of a degree centigrade. This technique may be applied to electronic parts and assemblies, and to certain types of structures (particularly honeycomb).

3.4.2 Infrared Electronic Techniques

The infrared technique as applied to electronic parts, subassemblies, and higher assemblies produces startling results. Through the use of this process, component parts can be screened on a 100 percent basis, and functional tests of assemblies can be combined with an operating temperature analysis. Virtually all potentially unreliable parts may be eliminated. The usefulness of the process depends on an early decision to screen out parts considered potentially unreliable that might pass under existing test techniques. These parts emit the widest variation of infrared radiation. This technique is based on detection and measurement of small differences of infrared radiation emitted from parts, subassemblies, or components when electrically energized and stabilized at their normal operating condition. The infrared "fingerprints" are compared with a distribution standard developed during qualification. Those units which are marginal or out of tolerance are considered sufficiently questionable to provide reason to reject the part or assembly.

This type of test is accomplished without any direct physical contact or any deleterious effects on the part or assembly. Infrared fingerprint photographs will be taken during manufacturing and during acceptance tests; these will be used in the analysis of the unit in the acceptance area and made a part of the component record.

3.4.3 Infrared Applied to Structures

The infrared technique for determining structural integrity is best applied to certain types of honeycomb construction. To determine the integrity of honeycomb structures, a uniform heat source is applied to one side of the sheet and a uniform heat sink is established on the other side. By IR photographic or scanning techniques the variations in infrared emissivity from the cool face are examined. Where the bonding is complete, a honeycomb pattern will show up in the photograph. Where bonding is improper and incomplete, holes or spaces will appear in the pattern indicating that the structural integrity has been compromised.

3.4.4 X-Ray, Ultrasonics, and Magnaflux

These and other nondestructive tests are common methods of testing materials and will not be discussed. For an index of detail procedures used at S&ID, refer to S&ID process specification MQ0501-008, "Inspection Requirements for Materials and Processed Parts."

4.0 APPLICATION

4.1 SUPPLIER ACCEPTANCE TESTS

4.1.1 Major Subcontractors

The major subcontractors selected by S&ID will be given a list of requirements that will form the basis of an acceptance procedure. The major subcontractor may add to or modify the requirements and write a detailed procedure that will be subject to S&ID approval. Included in the procedure will be a description of the test equipment used to assure compatibility with any acceptance test equipment used at the S&ID facilities (Downey or S&ID field sites). At a predetermined date and after sufficient notice has been given S&ID, a demonstration of acceptance test techniques on a system will be performed by the subcontractor and witnessed by Quality Assurance and Engineering personnel. Approval of the technical approach must be obtained prior to continuation of the tests as an acceptance test.

Upon completion of the acceptance test, if one parameter of the equipment is considered marginal, a review of in-process data (includes IR data) will be made by a review board of Apollo Engineering and Quality Assurance personnel prior to making a final decision for acceptance or rework. If rework is required, specific directions will be given.

Units of equipment scheduled for subcontractor qualification or for an outside commercial test laboratory will be subjected to the same acceptance test. The unit will be given a complete checkout when it is ready to undergo the environmental tests. The resulting data will be used as a point of reference for comparison with the succeeding environmental test results. This will provide an evaluation of the adequacy of the proposed acceptance test procedures, and assure qualification of the procedures as well as the equipment.

Although the subcontractor has given the equipment an acceptance test, he is responsible for the unit's operation until the actual mission is accomplished in accordance with the requirements of the equipment procurement specification.

4.1.2 Minor Subcontractors

Minor subcontractors or suppliers will also subject their units to an acceptance test. They will use test procedures written by S&ID Quality Engineering in accordance with the requirements of the procurement specifications. In all other aspects, the acceptance criteria for major subcontractors will apply.

4.1.3 Vendors

For equipment supplied by vendors of off-the-shelf items, control of the acceptance tests will be as shown for minor subcontractors with the exception of demonstration tests that will be required in a few instances. Negotiated control of the acceptance tests may be considered, otherwise S&ID will perform all screening and/or acceptance type tests to insure the adequacy of the item involved.

4.2 S&ID ACCEPTANCE TESTS

4.2.1 Receiving

Acceptance tests will be performed as required in this area on procured equipment. For economical reasons, major subcontractor equipment will undergo only an examination of product in the receiving area. The test facilities at the receiving inspection areas will not be adequate to test all units. To do this would entail costly duplication of laboratory equipment. Therefore, when required, Receiving Inspection will call on the services of support test laboratories for the functional testing of the units. The responsibility, in either case, for the acceptance or rejection of the units still lies with S&ID Receiving Inspection.

4.2.2 System Test Area

This is the area where the systems are checked out and then assembled into the vehicle. It is here that the equipment and subsystems received from major subcontractors undergo the first S&ID operational tests. Equipment obtained from minor subcontractors can be tested in this area also but only as part of a complete subsystem.

4.2.3 S&ID Manufactured Equipment

Upon completion of assembly and as a final checkout, acceptance tests are performed on S&ID equipment. Test procedures and the designation of associated test equipment are the responsibility of Design Engineering. A review of the procedures is made by Quality and Reliability Engineering, and any additional tests are included in the test document.

5.0 COMPONENT AND SUBSYSTEM ACCEPTANCE TEST REQUIREMENTS

All acceptance test procedures are based on the acceptance requirements incorporated in the equipment procurement specifications. These are shown in the tables of this section.

The acceptance test requirements shown are in addition to the normal inspection and examination of product for workmanship and cleanliness. (The information included in these tables is tentative and will be revised and supplemented as it becomes available.)

5.1 SERVICE PROPULSION SYSTEM

For requirements, see Table 5-1.

5.2 REACTION CONTROL SYSTEM

For requirements, see Table 5-2.

5.3 LAUNCH ESCAPE SYSTEM

For requirements, see Table 5-3.

5.4 EARTH LANDING SYSTEM

For requirements, see Table 5-4.

5.5 ENVIRONMENTAL CONTROL SYSTEM

For requirements, see Table 5-5.

5.6 ELECTRICAL POWER SYSTEM

For requirements, see Table 5-6.

5.7 GUIDANCE AND NAVIGATION SYSTEM

This system will not be included since S&ID will not have control of the suppliers acceptance tests.

5.8 STABILIZATION AND CONTROL SYSTEM

For requirements, see Table 5-7.

5.9 COMMUNICATIONS AND INSTRUMENTATION SYSTEM

For requirements, see Table 5-8.

5.10 LIFE SYSTEMS

For requirements, see Table 5-9.

5.11 GROUND SUPPORT EQUIPMENT (GSE)

The list of GSE is shown in Table 5-10. At present, the units are categorized as to modes of utilization, i.e., auxiliary, checkout, handling, and servicing. Each of these categories is again subdivided into two classes; mission-essential and mission-nonessential. Mission-essential GSE is associated with the subsystems that are directly involved in a closed-loop operation with the spacecraft system or subsystems, the function of which will have an effect on mission success or crew survival. Acceptance test requirements will be included at a later date.

Mission-nonessential GSE is utilized in the areas of checkout, staging, manufacturing, transport, handling, maintenance, recovery, shelter, etc.

5.12 MECHANICAL SYSTEM

For requirements, see Table 5-13.

5.13 THERMAL PROTECTION SYSTEM

For requirements, see Table 5-11.

5.14 DISPLAYS AND CONTROLS

The requirements for the displays and controls are shown in Table 5-12. This table contains each component part and subpanel assembly required to make up the display and control console. Table 5-12 is divided into three levels to show more clearly the extent and sequence of testing to be applied. The acceptance tests at level I are performed on component parts by the supplier. Level II acceptance tests are performed on subpanel assemblies by S&ID except as noted in the table. Level III designates console acceptance testing and will be performed by S&ID. The acceptance tests are programmed in this manner to eliminate duplication of testing.

Table 5-1. Service Propulsion System Requirements

System	Component	Acceptance Test Requirement
Service propulsion	Helium tank	(1) Leakage (2) proof pressure (3) X-ray (4) pressure drop
	Oxidizer tank	(1) Leakage (2) proof pressure (3) X-ray (4) pressure drop
	Fuel tank	(1) Leakage (2) proof pressure (3) X-ray (4) pressure drop
	Helium fill disconnect	(1) Proof pressure (2) leakage (3) operation (4) cleanliness
	Helium test disconnect	(1) Proof pressure (2) leakage (3) operation
	Oxidizer fill and drain disconnect	(1) Proof pressure (2) leakage (3) operation (4) cleanliness
	Oxidizer fill vent disconnect	(1) Proof pressure (2) leakage (3) operation (4) cleanliness
	Oxidizer test disconnect	(1) Proof pressure (2) leakage (3) operation
	Fuel fill and drain disconnect	(1) Proof pressure (2) leakage (3) operation (4) cleanliness
	Fuel fill vent disconnect	(1) Proof pressure (2) leakage (3) operation (4) cleanliness
	Fuel test disconnect	(1) Proof pressure (2) leakage (3) operation
	Helium solenoid valve	(1) Proof pressure (2) external leakage (3) dielectric strength (4) pressure drop (5) performance (6) internal leakage (7) insulation resistance

Table 5-1. Service Propulsion System Requirement (Cont)

System	Component	Acceptance Test Requirements
Service propulsion	Helium pressure regulator	(1) Proof pressure (2) leakage (3) flow (4) functional (5) cleanliness
	Check valve	(1) Proof pressure (2) leakage (3) pressure drop (4) cracking pressure
	Relief valve	(1) Proof pressure (2) leakage (3) functional (4) burst disc rupture (sample per MIL-STD-414) (5) cleanliness
	Quantity indicating and mixture ratio control system	(1) Hermetic sealing (2) dielectric strength (3) sensing device test (4) control unit (5) display panel assembly (6) valve assembly (proof pressure and leakage) (7) insulation resistance (8) cleanliness
	Heat exchanger, oxidizer	(1) Proof pressure (2) leakage (3) helium pressure drop (4) radiographic (5) cleanliness
	Heat exchanger, fuel	(1) Proof pressure (2) leakage (3) Helium pressure drop (4) radiographic (5) cleanliness
	Connector, flexible (oxidizer)	(1) Proof pressure (2) leakage (3) weld inspection (4) cleanliness
	Connector, flexible (fuel)	(1) Proof pressure (2) leakage (3) weld inspection (4) cleanliness
	S/M propulsion rocket engine	(1) Weight and balance (2) thrust vector location (3) leakage (4) firing tests (5) propellant valve assembly (proof, functional, leakage) (6) injector (waterflow, firing, proof) (7) ablative thrust chamber (proof, material bond, leakage) (8) gimbal actuator (integrity, cold gimballing) (9) thrust mount (bearing friction) (10) nozzle (radiograph weld and braze joints)

Table 5-2. Reaction Control System Requirements

System	Component	Acceptance Test Requirements
Reaction control system, service module	Helium tank	(1) Leakage, external (2) proof pressure (3) functional
	Oxidizer tank	(1) Leakage, external (2) proof pressure (3) functional (4) leakage, internal
	Fuel tank	(1) Leakage, external (2) proof pressure (3) functional (4) leakage, internal
	Helium fill disconnect	(1) Proof pressure (2) functional (3) leakage (4) operation (5) cleanliness
	Helium test disconnect	(1) Proof pressure (2) functional (3) leakage (4) operation (5) cleanliness
	Oxidizer fill and drain disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Oxidizer fill vent disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Oxidizer test disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Fuel fill and drain disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Fuel fill vent disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Fuel test disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Helium solenoid valve	(1) Proof pressure (2) leakage (3) dielectric strength (4) performance (5) pressure drop (6) cleanliness

Table 5-2. Reaction Control System Requirements (Cont)

System	Component	Acceptance Test Requirements
Reaction control system, service module	Oxidizer solenoid valve	(1) Proof pressure (2) leakage (3) dielectric strength (4) performance (5) pressure drop (6) cleanliness
	Fuel solenoid valve	(1) Proof pressure (2) leakage (3) dielectric strength (4) performance (5) pressure drop (6) cleanliness
	Helium fill disconnect	(1) Proof pressure (2) functional (3) leakage (4) operation (5) cleanliness
	Helium test disconnect	(1) Proof pressure (2) functional (3) leakage (4) operation (5) cleanliness
	Oxidizer fill and drain disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Oxidizer fill vent disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Oxidizer test disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Fuel fill and drain disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Fuel fill vent disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Fuel test disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Helium solenoid	(1) Proof pressure (2) leakage (3) dielectric strength (4) performance (5) pressure drop (6) cleanliness

Table 5-2. Reaction Control System Requirements (Cont)

System	Component	Acceptance Test Requirements
Reaction control system, service module	Oxidizer solenoid valve	(1) Proof pressure (2) leakage (3) dielectric strength (4) performance (5) pressure drop (6) cleanliness
	Fuel solenoid valve	(1) Proof pressure (2) leakage (3) dielectric strength (4) performance (5) pressure drop (6) cleanliness
	Helium pressure regulator	(1) Proof pressure and external leakage (2) internal leakage (3) functional (4) performance (5) internal leakage (6) cleanliness
	Check valve	(1) Proof pressure and external leakage (2) cracking pressure (3) pressure drop and flow rate (4) internal leakage (5) cleanliness
	Relief valve	(1) Proof pressure and external leakage (2) leakage (internal) (3) functional (4) burst disc rupture—25 percent of units (5) cleanliness
	Propellant gaging system	(1) Sensing device accuracy (2) indicator accuracy (3) telemetry signal accuracy (4) dielectric (5) insulation resistance (6) hermetic seal
Reaction control system, command module-service module	Flex hose	(1) Proof pressure (2) X-Ray (3) ball check
Reaction control system, command module	Helium tank	(1) Leakage, external (2) proof pressure (3) functional

Table 5-2. Reaction Control System Requirements (Cont)

System	Component	Acceptance Test Requirements
Reaction control system, command module	Oxidizer tank	(1) Leakage, external (2) leakage, internal (3) proof pressure (4) functional
	Fuel tank	(1) Leakage, external (2) leakage, internal (3) proof pressure (4) functional
	Helium fill disconnect	(1) Proof pressure (2) functional (3) leakage (4) operation (5) cleanliness
	Helium test disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Oxidizer fill disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Oxidizer fill vent disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Oxidizer test disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Fuel fill and drain disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Fuel fill vent disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Fuel test disconnect	(1) Proof pressure (2) leakage (3) operation (4) pressure drop
	Helium squib valve	(1) Proof pressure (2) leakage (internal) (3) external leakage (4) cleanliness

Table 5-2. Reaction Control System Requirements (Cont)

System	Component	Acceptance Test Requirements
Reaction control system, command module	Helium solenoid valve	(1) Proof pressure (2) leakage (3) dielectric strength (4) performance (5) pressure drop (6) cleanliness
	Oxidizer solenoid valve	(1) Proof pressure (2) leakage (3) dielectric strength (4) performance (5) pressure drop (6) cleanliness
	Fuel solenoid valve	(1) Proof pressure (2) leakage (3) dielectric strength (4) performance (5) pressure drop (6) cleanliness
	Helium pressure regulator	(1) Proof pressure and external leakage (2) internal leakage (3) functional (4) performance (5) internal leakage (6) cleanliness
	Check valve	(1) Proof pressure and external leakage (2) cracking pressure (3) pressure drop and flow rate (4) internal leakage (5) cleanliness
	Relief valve	(1) Proof pressure and external leakage (2) leakage (internal) (3) functional (4) burst disc rupture (25 percent of units) (5) cleanliness
	Oxidizer burst diaphragm	(1) Leakage (2) proof pressure (3) burst disc rupture—25 percent of units (4) pressure drop—25 percent of units (5) cleanliness
	Fuel burst diaphragm	(1) Leakage (2) proof pressure (3) burst disc rupture—25 percent of units (4) pressure drop—25 percent of units (5) cleanliness

Table 5-2. Reaction Control System Requirements (Cont)

System	Component	Acceptance Test Requirements
Reaction control	C/M RCS rocket engine	(1) Proof pressure (2) electrical check (3) leakage (4) engine burning test (5) performance (6) calibration
	S/M RCS rocket engine	(1) Electrical check (2) leakage (3) engine burning test (4) performance
	Propellant valves	(1) Dielectric (2) proof pressure (3) performance (4) calibration (5) leakage

Table 5-3. Launch Escape System Requirements

System	Component Part or Console	Acceptance Test Requirements
Launch escape system	Initiator, exploding bridge wire B/P #6 only	(1) Leakage (2) dielectric strength Comments: Lot acceptance (firing) test required
	Launch escape rocket motor	(1) Parts documentation checks (2) propellant document checks (weight) (3) CG and alignment checks (4) pressure test of motor assembly (5) ballistic acceptance (6) total weight (7) interchangeability (8) X-ray
	Pitch control motor	(1) Parts documentation checks (2) propellant document checks (3) CG and alignment checks (4) pressure test of motor assembly (5) ballistic acceptance (6) total weight (7) X-ray
	Tower jettison motor	(1) Parts documentation checks (2) propellant document checks (3) CG and alignment checks (4) pressure test of motor assembly (5) ballistic acceptance (6) total weight (7) X-ray
	Igniter cartridge, hot wire	(1) Bridgewire resistance (2) leakage (3) X-ray (4) weight (5) dielectric strength

Table 5-4. Earth Landing System Requirements

System	Component Part or Console	Acceptance Test Requirements
Earth landing system	Drogue parachute	(1) Inspection
	Pilot parachute	(1) Inspection
	Main parachutes	(1) Inspection
	Sequence controller	(1) Dielectric (2) functional (3) vibration
	Impact switch (unmanned flights only)	(1) Dielectric (2) functional
	Main chute disconnect	(1) Bridgewire resistance (2) dielectric (3) leakage (4) weight (5) X-ray
	Linear shaped charge	(1) Lot sampling firing
	Detonator cartridge	(1) Lot sampling firing
	Drogue mortar	(1) Lot sampling firing
	Drogue mortar cartridge and initiator	(1) Leakage (2) dielectric (3) bridgewire resistance (4) X-ray (5) lot sampling firing
	Pilot mortar cartridge and initiator	(1) Lot sampling firing
	Reefing line cutter	(1) Bridgewire resistance (2) dielectric (3) leakage (4) weight (5) X-ray

Table 5-4. Earth Landing System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Earth landing system	Linear shaped charge	(1) Lot sampling firing
	Detonator cartridge	(1) Lot sampling firing

Table 5-5. Environmental Control System Requirements

System	Component Part or Console	Acceptance Test Requirements
Environmental control system	Suit circuit return air check valve assembly	(1) Leakage (2) pressure drop (3) handle structural test and operational torque (4) X-ray
	Debris trap	(1) X-ray
	Suit compressor	(1) Volume or mass capacity (2) continuity impedance, accuracy, power regulation (3) pressure drop (4) X-ray (5) dielectric
	Suit compressor check valve	(1) Leakage (2) pressure drop
	CO_2 and odor absorber removable container	(1) Pressure drop (2) flow capacity (3) X-ray
	CO_2 and odor absorber assembly	(1) Pressure drop (2) flow capacity (3) X-ray
	Suit by-pass valve	(1) Flow capacity (2) handle structural test and operational torque (3) X-ray
	Suit air temp sensor	(1) Response time (2) sensitivity-repeatability (3) continuity, impedance, accuracy, power regulation (4) dielectric
	Suit air temp control	(1) Actuation time (2) continuity, impedance, accuracy, power regulation (3) response time, sensitivity-repeatability (4) (4) dielectric (5) X-ray

Table 5-5. Environmental Control System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Environmental control system	Suit air temp selector	(1) Continuity, impedance, accuracy, power regulation (2) sensitivity-repeatability (3) dielectric (4) X-ray
	Suit evap temp sensor	(1) Sensitivity-repeatability (2) response time (3) continuity impedance, accuracy, power regulation (4) dielectric
	Suit evap temp control	(1) Actuation time (2) response time, sensitivity-repeatability (3) continuity, impedance, accuracy, power regulation (4) X-ray (5) dielectric
	Heat exchanger assembly	(1) Heat transfer (2) volume or mass capacity (3) pressure drop (4) leakage (5) X-ray (6) dielectric
	Suit flow limiter	(1) Flow capacity (2) X-ray
	Suit hose connector assembly	(1) Leakage (2) volume or mass capacity (3) handle structural test and operational torque (4) X-ray
	Space radiator outlet check valve	(1) Leakage (2) pressure drop
	Glycol pressure relief valve	(1) Leakage (2) pressure relief, cracking and reseat pressures (3) X-ray
	Glycol check valve	(1) Leakage (2) pressure drop

Table 5-5. Environmental Control System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Environmental control system	Glycol evaporator	(1) Heat transfer (2) volume or mass capacity (3) pressure drop (4) leakage (5) X-ray
	Glycol electrical 3-way valve	(1) Leakage (2) continuity, impedance, accuracy, power regulation (3) X-ray (4) dielectric
	Cabin temp control valve	(1) Leakage (2) response time, sensitivity-repeatability (3) handle structural test and operational torque (4) continuity, impedance, accuracy, power regulation (5) X-ray (6) dielectric
	Space radiator temp control	(1) Leakage (2) response time, sensitivity-repeatability (3) continuity, impedance, accuracy, power regulation (4) dielectric (5) X-ray
	Glycol temp control	(1) Actuation time (2) response time, sensitivity-repeatability (3) continuity, impedance, accuracy, power regulation (5) X-ray (6) dielectric
	Glycol temp sensor	(1) Response time, sensitivity-repeatability (2) continuity, impedance, accuracy, power regulation (3) dielectric
	Glycol fill and vent connection	(1) Leakage (2) X-ray

Table 5-5. Environmental Control System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Environmental control system	Glycol shut-off valve	(1) Leakage (2) response time, sensitivity-repeatability (3) continuity, impedance, accuracy, power regulation (4) handle structural test and operational torque (5) X-ray
	Glycol reservoir	(1) Proof pressure (2) leakage (3) X-ray
	Glycol pump assembly	(1) Volume or mass capacity (2) pressure drop (3) leakage (4) X-ray (5) dielectric (6) continuity, impedance, accuracy, power regulation
	Glycol temp control valve	(1) Leakage (2) response time, sensitivity-repeatability (3) handle structural test and operational torque (4) continuity, impedance, accuracy, power regulation (5) X-ray (6) dielectric
	Glycol check valve	(1) Leakage (2) pressure drop
	Cabin pressure relief valve	(1) Leakage (2) flow capacity (3) pressure relief, cracking and reseat pressures (4) handle structural test and operational torque (5) X-ray
	Cabin heat exchanger	(1) Leakage (2) proof pressure (3) heat transfer (4) volume or mass capacity (5) X-ray
	Cabin temp selector	(1) Sensitivity-repeatability (2) X-ray (3) continuity, impedance, accuracy, power regulation (4) dielectric

Table 5-5. Environmental Control System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Environmental control system	Cabin temp anticipator	(1) Sensitivity-repeatability (2) response time (3) continuity, impedance, accuracy, power regulation (4) dielectric
	Cabin temp control	(1) Actuation time (2) response time, sensitivity-repeatability (3) continuity, impedance, accuracy, power regulation (4) X-ray (5) dielectric
	Cabin temp sensor	(1) Response time (2) sensitivity-repeatability (3) continuity, impedance, accuracy, power regulation (4) dielectric
	Cabin blower closure	(1) X-ray
	Cabin circulating blower	(1) Volume or mass capacity (2) continuity, impedance, accuracy, power regulation (3) X-ray (4) dielectric
	Cabin vent valve	(1) Functional (2) handle structural test and operational torque (3) X-ray (4) leakage
	Cabin pressure regulator	(1) Leakage, flow capacity and proof pressure (2) handle structural test and operational torque (3) cracking and reseat pressures (4) response time, sensitivity-repeatability (5) X-ray
	Back pack supply shut-off valve and cap	(1) Leakage (2) sensitivity-repeatability (3) handle structural test and operational torque (4) X-ray

Table 5-5. Environmental Control System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Environmental control system	Demand pressure regulator and relief valve	(1) Leakage, flow capacity, and proof pressure (2) cracking and reseat pressures (3) handle structural test and operational torque (4) response time, sensitivity-repeatability (5) X-ray
	Manual O_2 metering valve	(1) Leakage (2) sensitivity-repeatability (3) handle structural test and operational torque (4) X-ray
	Emergency O_2 inflow control valve	(1) Leakage, flow capacity, and proof pressure (2) cracking and reseat pressures (3) handle structural test and operational torque (4) response time, sensitivity-repeatability (5) X-ray
	Entry O_2 supply assembly	(1) Leakage, flow capacity, and proof pressure (2) cracking and reseat pressures (3) handle structural test and operational torque (4) response time, sensitivity-repeatability (5) X-ray
	O_2 pressure regulator assembly	(1) Leakage, flow capacity and proof pressure (2) cracking and reseat pressures (3) handle structural test and operational torque (4) response time, sensitivity-repeatability (5) X-ray
	Main O_2 supply check valve	(1) Leakage (2) pressure drop
	Water supply Q.D. and cap	(1) Leakage (2) proof pressure (3) X-ray

Table 5-5. Environmental Control System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Environmental control system	Water check valve	(1) Leakage (2) pressure drop
	Suit evap water inflow control valve	(1) Leakage (2) cracking and reseat pressures (3) sensitivity-repeatability (4) handle structural test and operational torque (5) X-ray (6) dielectric
	Potable water tank	(1) Leakage (2) proof pressure (3) X-ray
	Water chiller	(1) Leakage (2) flow capacity (3) heat transfer (4) X-ray
	Waste water tank	(1) Leakage (2) proof pressure (3) X-ray
	Manual shut-off valve	(1) Leakage (2) sensitivity-repeatability (3) handle structural test and operational torque (4) X-ray
	Water tank pressure relief valve	(1) Leakage, flow capacity, and proof pressure (2) cracking and reseat pressures (3) sensitivity-repeatability (4) handle structural test and operational torque (5) X-ray
	Potable water supply assembly	(1) Leakage (2) sensitivity-repeatability (3) X-ray (4) handle structural test and operational torque (5) continuity, impedance, accuracy, power regulation
	Water pressure relief valve	(1) Leakage, flow capacity, and proof pressure (2) cracking and reseat pressures (3) sensitivity-repeatability (4) X-ray (5) handle structural test and operational torque

Table 5-5. Environmental Control System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Environmental control system	Tank pressure control and relief valve	(1) Leakage, flow capacity, and proof pressure (2) cracking and reseat pressures (3) sensitivity-repeatability (4) X-ray (5) handle structural test and operational torque
	Freon storage assembly	(1) Leakage, flow capacity, and proof pressure (2) sensitivity-repeatability (3) handle structural test and operational torque (4) X-ray
	Pressure inlet, suit supply manifold	(1) Response time (2) sensitivity-repeatability (3) X-ray (4) continuity, impedance, accuracy, power regulation (5) dielectric
	Differential pressure suit compressor	(1) Response time (2) sensitivity-repeatability (3) continuity, impedance, accuracy, power regulation (4) X-ray (5) dielectric
	Temp, gaseous suit supply sensor	(1) Response time (2) sensitivity-repeatability (3) X-ray (4) continuity, impedance, accuracy, power regulation (5) dielectric
	Pressure outlet, glycol pump	(1) Response time (2) sensitivity-repeatability (3) X-ray (4) continuity, impedance, accuracy, power regulation (5) dielectric
	Pressure quantity measure, glycol accumulator	(1) Response time (2) sensitivity-repeatability (3) X-ray (4) continuity, impedance, accuracy, power regulation (5) dielectric

Table 5-5. Environmental Control System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Environmental control system	Pressure, gaseous, outlet, glycol evap	(1) Response time (2) sensitivity-repeatability (3) X-ray (4) continuity, impedance, accuracy, power regulation (5) dielectric
	Temp, gaseous, outlet, glycol evap sensor	(1) Response time (2) sensitivity-repeatability (3) X-ray (4) continuity, impedance, accuracy, power regulation (5) dielectric
	Temp outlet space radiator sensor	(1) Response time (2) sensitivity-repeatability (3) X-ray (4) continuity, impedance, accuracy, power regulation (5) dielectric
	Flow, O_2 supply	(1) Response time (2) sensitivity-repeatability (3) X-ray (4) continuity, impedance, accuracy, power regulation (5) dielectric
	Pressure, outlet, regulator, O_2 supply	(1) Response time (2) sensitivity-repeatability (3) X-ray (4) continuity, impedance, accuracy, power regulation (5) dielectric
	Pressure, entry O_2 bottles	(1) Response time (2) sensitivity-repeatability (3) X-ray (4) continuity, impedance, accuracy, power regulation (5) dielectric
	Temp, C/M, air, cabin sensor	(1) Response time (2) sensitivity-repeatability (3) X-ray (4) continuity, impedance, accuracy, power regulation (5) dielectric
	Pressure, C/M, cabin total	(1) Response time (2) X-ray (3) sensitivity-repeatability (4) continuity, impedance, accuracy, power regulation (5) dielectric

Table 5-5. Environmental Control System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Environmental control system	Pressure quantity measure, waste water tank	(1) Response time (2) dielectric (3) sensitivity-repeatability (4) X-ray (5) continuity, impedance, accuracy, power regulation
	Pressure quantity measure, potable water tank	(1) Response time (2) dielectric (3) sensitivity-repeatability (4) X-ray (5) continuity, impedance, accuracy, power regulation
	Temp power supply	(1) Response time (2) dielectric (3) sensitivity-repeatability (4) X-ray (5) continuity, impedance, accuracy, power regulation
	Temp amplifier sensor	(1) Response time (2) dielectric (3) sensitivity-repeatability (4) X-ray (5) continuity, impedance, accuracy, power regulation
	Cryogenic storage tanks	(1) X-ray (2) proof pressure
	Cryogenic storage assembly	(1) Examination (2) dielectric STR (3) functional
	Transducer pressure reentry O_2 supply	(1) Continuity, impedance, accuracy, power regulation (2) response time, sensitivity-repeatability (3) functional

Table 5-6. Electrical Power System Requirements

System	Component Part or Console	Acceptance Test Requirements
Electric power system	Static inverter	(1) Dielectric strength (2) voltage and frequency regulation (3) short circuit protection (4) efficiency (5) phase rotation (6) enclosure leakage
	Battery charger	(1) Dielectric strength (2) charging current and voltage regulation (3) overload and short circuit (4) gas leakage
	Battery	(1) Seals leakage (2) rupture pressure (cell relief valve opening) (3) intercell connectors (voltage drop) (4) insulation (5) rated capacity discharge
	Relay, general purpose	(1) Leakage (2) dielectric strength (3) coil resistance (4) pick-up and drop-out voltage (5) pick-up drop-out time (6) contact resistance
	Interior floodlight	(1) Illumination (2) dielectric strength
	Power transfer switch	(1) Dielectric strength (2) contact resistance (3) performance (4) switch time (5) motor current (6) transients (7) operation of auxiliary contacts
	Electrical feed throughs	(1) Dielectric strength (2) leakage
	Circuit breakers	(1) Dielectric strength (2) performance (3) enclosure leakage

Table 5-6. Electrical Power System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Electric power system	Firing unit	(1) Dielectric strength (2) functional test charging current and charge time, capacitor monitor voltage, trigger circuit response time, peak trigger circuit input current, steady state trigger circuit input current, bleeder discharge time, storage capacitor discharge time, trigger circuit sensitivity, power supply cutoff, and firing unit output
	Connector umbilical C/M to S/M	(1) Contact separation (2) contact resistance (3) dielectric strength
	Harness installation LES	(1) Contact separation (2) contact resistance (3) dielectric strength (4) continuity and short checkout
	Harness installation C&D	(1) Contact separation (2) contact resistance (3) dielectric strength (4) continuity and short checkout
	Fuel cell assembly module	Performance Voltage, current, waterflow, reactant flow rate, reactant pressure, no blanket pressure, module temperature, water pH Comments: Operate the fuel cell 6 hours and record the data shown. Electrical Check (1) Dielectric strength (2) insulation resistance (3) check for insulation breakdown pressure decay rate of N_2, O_2, and H_2 gas systems
	Radiator	Leakage and proof pressure

Table 5-7. Stabilization and Control System Requirements

System	Component Part or Console	Acceptance Test Requirements
Stabilization and control	System	Power switch checks (system level tests)
	RGP	(1) Gyro spin motor (2) running checks (3) gyro scale factor (4) torquer output phasing
	AGAP	(1) Attitude gyro operating temperature (2) gyro cage and uncage time (3) scale factor tests (4) accelerometer null (5) accelerometer torquing signal
	Three-axis rotation control	(1) Hand control (2) pitch, yaw, and roll output (3) voltage and phasing normal and emergency modes (manual mode)
	Thrust control	(1) Thrust control voltages to RCS motors (2) thrust control interlocks (3) gimbal engine servo-null outputs (4) servo-amplifier differential clutch current (position and rate feedback)
	AS/GPD	(1) Gimbal angle position indication (2) gimbal displacement and phasing (3) servo-loop frequency response (4) yaw servo-velocity limits (5) yaw servo threshold
	FDAI	(1) Gyro rate and attitude signals (monitor mode torque gyros and read outputs on FDAI) (2) gyro output pulse patterns (torque gyros and record pulse patterns) (3) FDAI error displacement (G&N attitude control mode simulate errors and measure response)

Table 5-7. Stabilization and Control System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Stabilization and control	ECA	(1) Pitch yaw and roll error voltages (2) pitch yaw and roll channel nulls (SCS attitude control mode compare error voltages with stimuli)
	ΔV	(1) Engine interlock checks (2) ΔV engine fire command signal (3) engine ignition signal (4) engine cut-off signal (both SCS and G&N ΔV modes)
	Rate and attitude modes	(1) Sensitivity (2) linearity error (3) threshold (4) zero offset (5) hysteresis (6) residual null (7) output continuity (8) gyro sense (9) stops (10) synchronizing time (11) static unbalance (12) cross coupling (13) natural frequency (14) dynamic response (15) torquer linearity (component level checks)

Table 5-8. Communications and Instrumentation System Requirements

System	Component Part or Console	Acceptance Test Requirements
Communication	HF transceiver	(1) Low-level vibration (2) AGC voltage measurement (3) receiver I-F amplifier output voltage (4) receiver audio output voltage (5) transmitter output stage plate voltage (6) transmitter output stage plate current (7) transmitter mode output voltage
	VHF/AM transmitter-receiver equipment	(1) Low-level vibration (2) AGC voltage measurement (3) receiver I-F amplifier output voltage (4) receiver audio output voltage (5) transmitter output stage plate voltage (6) transmitter output stage plate current (7) transmitter modulation output voltage
	VHF/FM transmitter equipment	(1) Low-level vibration (2) transmitter output stage plate current (3) transmitter output stage plate voltage (4) transmitter AFC voltage (5) drive level at output of exciter
	Audio center equipment	(1) Low-level vibration (2) measurement of earphone amplifier AVC (3) measurement of microphone amplifier AVC (4) PTT voltage
	C-Band transponder equipment	(1) Low-level vibration (2) transmitter output monitor (3) crystal current No. 1 (4) crystal current No. 2 (5) crystal current No. 3 (6) crystal current No. 4 (7) receiver video No. 1 (8) receiver video No. 2 (9) receiver video No. 3 (10) receiver video No. 4 (11) pulser output waveform No. 1 (12) pulser output waveform No. 2

Table 5-8. Communications and Instrumentation System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Communication	C-Band transponder equipment	(13) power supply TP 1 (14) power supply TP 2 (15) power supply TP 3 (16) power supply TP 4 (17) modulator trigger waveform
	DSIF power amplifier equipment	(1) low-level vibration (2) TWT: output voltage moditor (3) TWT: anode volts monitor (4) TWT: helix volts monitor (5) TWT: collector volts monitor (6) TWT: grid volts monitor
	DSIF transponder equipment	(1) Low-level vibration (2) VCO/ crystal control voltage (3) receiver AGC voltage (4) all oscillator frequencies (5) receiver VCO output level (6) auxiliary oscillator output level (7) modulation input signal (8) transmitter output voltage (9) all power supply voltages (10) all phase detector outputs (11) 1st I-F amplifier output (12) 2nd I-F amplifier output (13) mixer-preamplifier output (14) VCO input
	PCM telemetry equipment	(1) Low-level vibration (2) electrical performance
	R&D VFH omni-antenna equipment	(1) Low-level vibration (2) VSWR
	R&D telemetry antenna equipment	(1) Low-level vibration (2) VSWR
	R&D beacon antenna system	(1) Low-level vibration (2) VSWR

Table 5-8. Communications and Instrumentation System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Communication	VHF recovery beacon	(1) Power output measurement (2) frequency stability (3) output characteristics (4) pulse group spacing (5) pulse code spacing (6) pulse width (7) rise time (8) fall time (9) CW characteristics (10) low-level vibration
	Controls and display equipment	(1) Low-level vibration (2) electrical performance
2KMC Hi-gain antenna system	Antenna + gimbals, rotary joints, sensors gimbal drive	Mechanical-(1) operation of gimbal drives (2) tracking rate check (3) low-level vibration Electrical-(1) VSWR (2) sensor check (3) insertion loss check (4) gain and beam width check
Recovery antenna system	Antenna, squib activating mechanism	Mechanical-(1) manual activation Electrical-(1) VSWR (2) insertion loss Vibration
Operational beacon antenna system	Antenna	Electrical-(1) VSWR (2) insertion loss
Radome	Radome	Inspection, electrical and vibration
VHF 2KMC Scin antenna system	Antenna and abalative material	Electrical-(1) VSWR (2) insertion loss (3) reflectivity Vibration
R&D beacon antenna system	Antenna, power divider	Electrical-(1) VSWR (2) insertion loss
R&D telemetry antenna system	Antenna, power divider	Electrical-(1) VSWR (2) insertion loss Vibration

Table 5-8. Communications and Instrumentation System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
R&D VHF omni antenna system	Antenna and radome	Electrical-(1) VSWR (2) insertion loss (3) reflectivity Vibration
Instrumentation	Data patch panel	(No requirements to date)
	Central timer	(1) Stability (2) jitter (3) output frequencies (4) output waveforms (5) rise-fall time (6) synchronization to external frequencies
	Temperature transducer	(1) Linearity (2) output regulation (3) thermal stability (4) hysteresis
	Leak detection system	(1) Linearity (2) regulation
	Linear accelerometer transducer	(1) Linearity (2) output regulation (3) output signal (4) voltage regulator (5) frequency response
	Vibration measurement system	(1) Linearity (2) regulation
	Stress measurement system	(1) Linearity (2) regulation (3) hysteresis
	Acoustical measurement system	(1) Linearity (2) regulation
	Flow transducer	(1) Linearity (2) regulation
	Pressure transducer	(1) Linearity (2) regulation (3) hysteresis
	Linear displacement transducer	(1) Linearity (2) regulation (3) hysteresis

Table 5-8. Communications and Instrumentation System Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Instrumentation	Angular displacement transducer	(1) Linearity (2) regulation (3) hysteresis
	Radiation instrumentation	(No requirements defined to date)
	Fluid quantity measurement system	(1) Linearity (2) regulation
	TV camera	(1) Sensitivity (2) synchronization (3) output waveform (4) stability

Table 5-9. Life Systems Requirements

System	Component Part or Console	Acceptance Test Requirements
Life systems		
Crew provisions	Water delivery assembly	(1) Proof pressure and leakage (2) operational
	Cleansing pads	Lot sampling - (1) bacteriological (2) acidity (3) absorption (4) toxicological (5) functional (6) package leakage
	Ingestible dentrifice	Lot sampling - (1) bacteria count (2) toxicological (3) package leakage
	Deodorant pad	Lot sampling - (1) bacteriological (2) acidity (3) absorption (4) toxicological (5) package leakage
	Mouth piece, food	(1) Odor (2) coupling
	Portable light	(1) Battery voltage (2) lamp bulb resistance (3) candle power output (4) switch resistance (5) operation
	Personal shaver	(1) Functional
	Personal shoe-straps	(1) Peel strength
	Plastic H_2O container, survival	(1) Weight (2) leakage (3) lot sampling: (a) sterility (b) H_2O potability (c) H_2 ion ph valve
	Fecal/emesis bag	Lot sampling (1) leakage (2) bacteriological
	Hose assembly, umbilical	(1) Proof pressure and leakage (2) functional

Table 5-9. Life Systems Requirements (Cont)

System	Component Part or Console	Acceptance Test Requirements
Crew provisions	Delivery assembly, water	(1) Proof pressure and leakage (2) functional
	Balloon-kite, survival	(1) Gas generation (lot) functional (2) leakage
Waste management subsystem	Control unit	(1) Proof pressure (2) flow and ΔP (3) leakage
	Vacuum cleaner	(1) Flow and ΔP (2) leakage (3) functional
	Bacteria control	(1) Flow and ΔP (2) proof pressure (3) functional
	Disposal lock	(1) Flow and ΔP (2) proof pressure (3) functional
	Check valve	(1) Flow and ΔP (2) proof pressure (3) cracking pressure
	Backup valve	(1) Flow and ΔP (2) proof pressure (3) operating torque
	Blower	(1) Dielectric strength (2) functional

Table 5-10. Ground Support Equipment Requirements*

Category	Console
GSE-Auxiliary mission nonessential	Launch escape tower intermodule simulator
	C/M intermodule simulator
	Pyrotechnic initiators simulator set
	C/O control intercom set
	LES optical alignment set
	S/C adapter cover
	C/M cover
	Ground cooling cart
	Cover set - S/C transport
	Pad abort adapter
	Cleaning positioner
	Maintenance and storage trailer
	S/M simulator
	S/C adapter intermodule simulator
	Launch vehicle intermodule simulator
	S/M cover
	Launch vehicle intermodule simulator C-1
	LES cover
	Vacuum cleaner set
	Cap and plug set
	Adapter cap and plug set

*New GSE requirements were not available in time for this publication date and will be shown in the next revision.

Table 5-10. Ground Support Equipment Requirements (Cont)

Category	Console
GSE-Auxiliary mission nonessential	Optical alignment set
	G/M GSE verification simulator
	S/M GSE verification simulator
	C/M fluid systems intermodule simulator
	S/M fluid systems intermodule simulator
	Metabolic simulator
	Pressure distribution unit
	Vacuum cleaner
	Ground air circulating unit
	Adapter and duct set
	Launch escape motor dummy
	LE jettison motor dummy
	LE kicker motor dummy
	Protective closure and installation kit, nozzle extension
	Nozzle closure (dust cover)
	Nozzle plug
	Control-crane, auxiliary
	Box level
	ELS equipment simulator set

Table 5-10. Ground Support Equipment Requirements (Cont)

Category	Console
GSE-Auxiliary mission essential	Disconnect set-umbilical (fluid and electrical)
	Disconnect set-umbilical (fluid and electrical)
	Gyro heater and temperature controller
GSE- Checkout mission nonessential	Carry-on test adapter
	Protractor set
	Test conductor/assistant test conductor console
	Data recording group
	Telemetry ground station (R&D)
	Telemetry ground station
	Data transmission system and distribution center
	Telemetry C/O unit
	Launch escape sequencer B/M equipment
	Telemetry instrument van
	Antenna C/O group
	Telemetry station B/M equipment
	C/M and S/M electrical power system B/M equipment
	G&N system B/M equipment
	Crew system B/M
	C/M and S/M reaction control B/M equipment

Table 5-10. Ground Support Equipment Requirements (Cont)

Category	Console
GSE-Checkout mission nonessential	Pyrotechnics B/M equipment
	Pyrotechnics system and sequencer monitor and control equipment
	R&D instrumentation B/M equipment
	In-flight test and maintenance system B/M equipment
	C/M and S/M electrical power system monitor and control equipment
	Electrical umbilical disconnect set
	Environmental control system monitor and control equipment
	Tele. comm. system monitor and control equipment
	Crew system monitor and control equipment
	C/M and S/M reaction control system monitor and control equipment
	Propulsion test control group
	Propulsion system B/M equipment
	Fuel cell power plant test stand
	Propulsion system monitor and control equipment
	Mobile data recorder
	Telemetry/radar/command monitor equipment
	Prototype SCS B/M equipment

Table 5-10. Ground Support Equipment Requirements (Cont)

Category	Console
GSE-Checkout mission nonessential	Prototype SCS monitor and control equipment
	SCS B/M auxiliary equipment
	S/C panels monitor console
	Cable set electrical
	ECS high pressure gaseous B/M test stand
	ECS low pressure gaseous B/M test stand
	Radar transponder and recovery beacon C/O unit
	Command receiver C/O unit
	ECS liquid B/M test stand
	ECS major subassembly B/M test stand
	Test set nozzle extension flange leak test
	Earth landing system sequencer B/M equipment
	Exploding bridge wire firing unit B/M equipment
	Signal conditioner console
	Umbilical junction box
	Test fixture Q ball
	C/M manual test unit (CSTU)
	S/M manual test unit (CSTU)
	Data equipment B/M equipment

Table 5-10. Ground Support Equipment Requirements (Cont)

Category	Console
GSE-Checkout mission nonessential	DSIF transponder and power amp equipment B/M equipment C-band transponder equipment B/M equipment Communications and antenna equipment B/M equipment
GSE-Checkout mission essential	C/M and S/M electrical power system C/O group Bardo switch test unit G&N system vicinity equipment Telecommunications C/O group Crew system C/O group C/M and S/M reaction control system C/O group Pyrotechnic system and sequencer C/O equipment Checkout computer Checkout computer accessory group In-flight test and maintenance system C/O group Electrical junction box set Power distribution group On-board recorder C/O unit Calibration unit

Table 5-10. Ground Support Equipment Requirements (Cont)

Category	Console
GSE-Checkout mission essential	Propulsion system C/O group
	N&G system monitor and control equipment
GSE-Handling mission essential	Sling launch escape tower
	C/M support
	Mobile workstand B/P adjust
	Launch escape alignment stand
	LES weight and balance fixture
	S/C weight and balance fixture
	Escape tower support
	C/M equipment handling set
	S/M sling
	S/M propulsion engine sling
	Adapter rail transfer flow skirt
	Sling flow skirt
	S/M support
	Base stand, support
	S/M workstand
	S/C adapter workstand
	Anthropomorphic dummy handling harness
	Maintenance stand
	S/C vertical transport vehicle

Table 5-10. Ground Support Equipment Requirements (Cont)

Category	Console
GSE-Handling essential	Propulsion development test, ground adapter
	Anthropomorphic dummy storage rack
	Electronic weighing kit (3000-pound capacity)
	Electronic weighing kit (30,000-pound capacity)
	Hoist beam, S/M and S/C adapter
	Sling, jettison motor
	Positioning trailer, narrow base
	Jettison motor support
	LES motor support
	Heat shield sling
	FWD compartment shield sling
	Aircraft loading set
	S/M and C/M adapter weight and balance set
	Fuel and oxidizer tank sling
	Fuel and oxidizer tank support
	Helium tank sling
	Helium tank support
	LO_2 tank sling
	LO_2 tank support

Table 5-10. Ground Support Equipment Requirements (Cont)

Category	Console
GSE-Handling essential	Antenna sling
	Antenna support
	LH_2 tank sling
	Hydrogen tank support
	Mission propulsion engineering support
	Spacecraft sling (without LES)
	Spacecraft sling (with LES)
	Support base, S/C
	Fuel cell power plant service dolly
	Cradle, transport LES
	Adapter roll-over
	Sling-horizontal handling LES and LES motor
	Support base assembly, tubular B/P
	Heat shield CG weight and balance set
	G&N polarity test fixture
	Stand-access, recovery area
	Stand-access, C/M hatch
	Sling-kicker motor interstage structure
	Boatswain's chair
	Sling, jettison motor, kicker motor, nose cone

Table 5-10. Ground Support Equipment Requirements (Cont)

Category	Console
GSE-Handling essential	Access stand, tower adjustment area
	Hook, ballast pickup LES
	Stand-access, LES buildup
	Handling and installation set-RCS
	Sling set C/M test vehicle
	Adapter B/P fitting set
	Sling set, weight and balance
	Sling assembly-test vehicle adapter
	Jack set, weight and balance
	Equipment handling set
	S/M sling
	Bridle-parachute, boilerplate
	B/P 25 - base support
	Base support, S/M and adapter
	Heat shield sling
	S/M and S/C adapter weight and balance fixture
	S/C boilerplate sling
	General purpose dolly
	Sling, access door S/M
	C/M support base
	Support stand

Table 5-10. Ground Support Equipment Requirements (Cont)

Category	Console
GSE-Servicing **nonessential**	Extended storage desiccant system
	Fluid distribution and cable system swing arm No. 1
	Fluid distribution and cable system swing arm No. 2
	Fluid distribution system (House S/C)
	Battery charging unit
	Inerting and safing recovery unit
	Helium booster unit
	Helium tank desiccant system
	LH_2 tank desiccant system
	N_2O_4 tank desiccant system
	50-50 UDMH N_2H_4 tank desiccant system
	LO_2 tank desiccant system
	Vacuum cleaner servicing unit
	Water glycol cooling unit
	Ethylene glycol fluid trim control set
	Fuel cell power plant glycol service unit
	Servicing unit R&D instrument cooling system

Table 5-10. Ground Support Equipment Requirements (Cont)

Category	Console
GSE-servicing essential	Module leak test unit
	N_2O_4 transfer unit
	Mass spectrometer leak tester
	Water transfer unit
	Re-entry oxygen supply unit
	50-50 UDMH and N_2H_4 transfer unit
	Helium transfer unit
	Freon supply unit
	Ethylene glycol water transfer unit
	LH_2 transfer unit
	LO_2 transfer unit
	N_2 pressurization

Table 5-11. Thermal Protection System Requirements

System	Component Part or Console	Acceptance Test Requirements
Thermal protection	Heat shield	(1) Dielectric strength (2) X-ray (3) eddy current
	High vacuum insulation	

Table 5-12. Display and Controls Requirements

System Level	Component Part or Subpanel Assembly	Acceptance Test Requirements
Level I	Timer, event digital countout	(1) Functional (2) vibration (3) 10-hour temperature stability test (4) seal test
	Lamp, Incandescent	(1) Candle power check (2) power consumption (3) light performance test (sampling plan)
	GMT display	(1) Functional (2) vibration (3) 10-hour temperature stability test
	Timer, event, LEB	(1) Functional (2) vibration (3) 10-hour temperature stability test (4) seal test
	Indicator, barametric	(1) Functional (2) vibration (3) seal test
	Meter, electrical	(1) Functional (2) Reverse voltage (3) over voltage (4) response time (5) vibration (6) seal test (7) 10-hour temperature stability test
	Rheostat	(1) Resistance (2) power dissipation (3) vibration (4) seal test
	Indicator, event	(1) Functional (2) vibration (3) seal test
	Switch, toggle	(1) Functional (2) vibration (3) seal test (4) insulation resistance
	Switch, rotary	(1) Functional (2) insulation resistance (3) dielectric strength test (4) vibration
	Annunciator assembly	(1) Continuity check (2) brightness check (3) color of illumination check (4) dielectric test (5) vibration

Table 5-12. Display and Controls Requirements (Cont)

System Level	Component Part or Subpanel Assembly	Acceptance Test Requirements
Level I	Potentiometer	(1) Resistance and continuity (2) insulation resistance (3) dielectric strength (4) power dissipation (5) vibration (6) torque
	Clock, mechanical, LEB	(1) Functional (2) 10-hour temperature stability test
	Switch, push-buttom	(1) Functional (2) insulation resistance (3) dielectric strength (4) vibration (5) seal test
Level II	*Entry monitor display unit	(1) Functional (2) vibration (3) servo-motor checkout (position of indicator versus signal accuracy)
	Emergency detection system and sequencer display	(1) Functional checkout (2) vibration (3) threshold voltage check on all input channels
	*Flight detection attitude indicator (SCS)	(1) Circuit checkout operation (2) vibration (3) input voltage versus meter reading, i.e., calibration check
	Emergency detection system and sequencer display	(1) Functional (2) vibration (3) continuity (4) signal voltage versus digital reading, calibration check (5) switch circuit check for operation
	*Attitude set and GPD	(1) Functional (2) vibration (3) input voltage versus meter reading, calibration check
	*ΔV Control panel	(1) Functional (2) vibration
	Panel No. 8 (spare)	None

*These panel assemblies will be acceptance tested by the subcontractor.

Table 5-12. Display and Controls Requirements (Cont)

System Level	Component Part or Subpanel Assembly	Acceptance Test Requirements
Level II	*SCS control and mode select	(1) Functional (2) vibration (3) continuity
	Master caution, left-hand	(1) Functional (2) vibration (3) threshold voltage level checkout on all channels
	Master caution, right-hand	(1) Functional (2) vibration (3) threshold voltage level checkout on all channels
	RCS, GMT, static port valve	(1) Functional (2) vibration (3) signal-meter correlation and accuracy check
	Radiation, audio, cryogenic and ECS system	(1) Functional (2) vibration (3) calibration check
	*G&N computer control	(1) Functional (2) vibration (3) signal voltage versus digital reading (4) digital sequencing
	Reaction control system	(1) Functional (2) vibration (3) threshold voltage level checkout on all channels (4) switching circuit continuity check
	Crew safety control panel	(1) Functional (2) vibration (3) switching checkout
	Oxygen warning	(1) Functional (2) vibration (3) threshold voltage level
	Fuel cells and electrical power system	(1) Functional (2) vibration (3) threshold voltage level checkout on all channels (4) switching circuit continuity check
	Antenna control system	(1) Functional (2) vibration (3) signal-meter correlation and accuracy check

*These panel assemblies will be acceptance tested by the subcontractor.

Table 5-12. Display and Controls Requirements (Cont)

System Level	Component Part or Subpanel Assembly	Acceptance Test Requirements
Level II	Communications data-link and service propulsion system	(1) Functional (2) vibration (3) continuity (4) signal voltage versus meter reading, calibration check (5) switch circuit check for operation
	Right-hand side console, bus switching	(1) Functional (2) vibration (3) continuity
	Right-hand side console, circuit breaker and bus switching	(1) Functional (2) vibration (3) switching circuit continuity check
	Right-hand side console, audio and lighting control	(1) Functional (2) vibration (3) switching circuit continuity check
	Left-hand side console, mission sequence controls	(1) Functional (2) vibration (3) continuity
	Left-hand side console, circuit breaker and SCS power	(1) Functional (2) vibration (3) control switch checkouts continuity
	Left-hand side console, audio and lighting controls	(1) Functional (2) vibration (3) control switch checkouts continuity
	*In-flight test system	(1) Functional (2) vibration (3) go no-go threshold check on all channels
Level III	Console	(1) Functional (2) vibration (3) threshold voltage level checkout on all channels (4) signal-meter correlation and accuracy check

*These panel assemblies will be acceptance tested by the subcontractor.

Table 5-13. Mechanical System Requirements

System	Component	Acceptance Test Requirements
Mechanical Devices	Actuating system, astro-sextant door	(1) Ground operational
	Controls, push-pull, rigid	(1) Functional
	Latch, flush-mounted	(1) Functional
	Crew couch shock struts	Lot sample (1) Functional
	Crew hatch actuating system	(1) Seal test (2) Functional
Location Aids	Flashing beacon light	(1) Dielectric strength (2) immersion test (3) functional
	Sofar bomb and ejector	Sofar bomb - (1) X-ray (2) immersion test Ejector - (1) cycling Lot sampling, Sofar bomb - (1) vibration (2) shock (3) functional
	Dye marker and ejector	Dye marker - (1) dye material (2) packet Ejector - (1) cycling
Pyrotechnic Devices	Initiator, hot wire	(1) Leakage (2) dielectric (3) bridgewire resistance (4) X-ray Lot sampling test: firing
	Pressure cartridge (Types I, II, III)	(1) Bridgewire resistance (2) dielectric (3) leakage (4) weight (5) X-ray Lot sampling: firing
	Linear-shaped charge	Lot sample (1) X-ray (2) Weight

Table 5-13. Mechanical System Requirements (Cont)

System	Component	Acceptance Test Requirements
Pyrotechnic Devices	Detonator cartridge	As above
	Explosive bolt (launch escape tower separation system)	(1) Hardness (2) leakage (cartridge only) (3) dielectric (4) bridgewire resistance (5) X-ray Lot sampling test: firing

6.0 SYSTEM ACCEPTANCE TEST REQUIREMENTS

At present no information is available. Data will be supplied at a later date.

NOMENCLATURE

A listing of the special nomenclature and abbreviations used in this report is presented. These listings may appear interchangeably with their full definitions in the text. Accepted abbreviations for units of physical measurement such as volts, ohms, etc. are not included.

Abbreviation	Definition
AEDC	Arnold Engineering Development Center
AFMTC	Air Force Missile Test Center
AFRM	Airframe
AGAP	Attitude gyro and accelerometer package
AGC	Aerojet-General Corporation
AGC	Apollo guidance computer
AGC	Automatic gain control
AGREE	Advisory group on reliability of electronic equipment
AMR	Atlantic Missile Range
ATO	Apollo Test and Operations
BAL	Balance
BCD	Binary coded decimal
B-#	Boilerplate - # (with specific number)
B/M	Bench maintenance
BMAG	Body-mounted attitude gyros
BOD	Beneficial occupancy date
B/P	Boilerplate

Abbreviation	Definition
CCMTA	Cape Canaveral Missile Test Annex
C&D	Controls and displays
CDS	Communications and data subsystems
CDU	Coupling display unit
CG	Center of gravity
C&IS	Communications and instrumentation system
C/M	Command module
C/O	Checkout
C-O	Crew operated
CP	Control panel
CTU	Central timing unit
CVR	Change verification record
DEA	Display electronic assemblies
DF	Direction finding
DOD	Department of Defense
DOF	Degrees of freedom
DP	Design proof
DPT	Design proof test
DSIF	Deep Space Instrumentation Facility

Abbreviation	Definition
DVD	Differential velocity display
EBW	Exploding bridge wire
ECA	Electronic control assembly
ECS	Environmental control system
EDL	Engineering Development Laboratory (S&ID Dny)
ELS	Earth landing system
EMI	Electromagnetic interference
EPS	Electrical power system
ET	Escape tower
FDAI	Flight director attitude indicator
FM	Frequency modulation
FAX	Facsimile transmission
G, g	Acceleration of gravity
G&NS	Guidance and navigation system
GOSS	Ground operational support system
GP	General purpose
GPI	Gimbal position indicator
GSE	Ground support equipment
HAA	High-altitude abort
HBW	Hot bridge wire
H/A	Hazardous area

Abbreviation	Definition
IFT&M	In-flight test and maintenance
IMCC	Integrated Mission Control Center
IMU	Inertial measurements unit
INT	Interior
INST REF	Instrument reference
IRIG	Inter-range instrumentation group
L-	Time before launch (days)
LAD	Los Angeles Division (of NAA)
L/D	Length-diameter ratio
LEM	Lunar excursion module
LEV	Launch escape vehicle
LES	Launch escape system
LJII	Little Joe II
LOR	Lunar orbit rendezvous
LSS	Life support system
L/V	Launch vehicle
MDSS	Mission data support system
M-#	Mock-up - # (with specific number)
Max q	Maximum dynamic pressure
MEE	Mission essential equipment

Abbreviation	Definition
MIT	Massachusetts Institute of Technology
MLT	Mission life test
MNEE	Mission non-essential equipment
MSC	Manned Spacecraft Center (NASA, Houston, Texas)
MTBF	Mean time before failure
MTTR	Mean time to repair
NAA	North American Aviation
NASA	National Aeronautics and Space Administration
O/F	Oxidizer-to-fuel ratio
OPS	Operations
OTP	Operational test procedure
PA	Power amplifier
PACE-S/C	Prelaunch automatic checkout equipment - spacecraft
PAM	Pulse amplitude modulation
PCM	Pulse coded modulation
PCM	Pulse code modulator
PDM	Pulse duration modulation
P_f	Probability of failure
P_{f_p}	Probability of performance failure
P_{f_s}	Probability of stress failure
PFRT	Preliminary Flight Rating Test
POD	Prelaunch Operations Division (NASA)

Abbreviation	Definition
P_s	Probability of success
PSA	Power and servo assembly
PTT	Push to talk
PUCS	Propellant utilization control system
P&WA	Pratt & Whitney Aircraft
R/B	Radar beacon
R/C	Radio command
RCC	Range control center
RCS	Reaction control system
R&D	Research and development
REG	Regulator
RF	Radio frequency
RFI	Radio frequency interference
RFWAR	Requirements for work and resources
RGP	Rate gyro package
R&Z	Range and zero
SA	Saturn Apollo
SCAT	Space communications and tracking
SCD	Specification control drawing
SCIP	Self-contained instrumentation package
SCO	Subcarrier oscillator
SCR	Silicon-controlled rectifier

Abbreviation	Definition
SCT	Scanning telescope
S/C	Spacecraft
S/C_a	Spacecraft adapter
SCS	Stabilization and control system
SEP	Space electronic package
S&ID	Space and Information Systems Division (of NAA)
S/M	Service module
SOL	Solenoid
SOFAR	Sound fixing and ranging
STU	Systems test unit
SPS	Service propulsion system
SXT	Sextant
T-	Time before launch
T-O	Time of launch
T+	Time after launch
T/M	Telemeter
TP	Test Point
TPA	Test preparation area
TPS	Thermal protection system
T/R	Transmitter receiver (combination in two packages)
TWT	Traveling wave tube
TWX	Teletype wire transmission
UDMH	Unsymmetrical dimethyl hydrazine

Abbreviation	Definition
VCO	Voltage controlled oscillator
VLF	Vertical launch facility
VSWR	Voltage standing wave ratio
WSMR	White Sands Missile Range
XCVR	Transceiver (transmitter receiver in one package)

DEFINITION OF TERMS

ABLATE	To carry away; to remove by cutting or erosion, melting or evaporation. To undergo ablation; to become melted or vaporized and removed at a very high temperature.
ABORT	An uncompleted missile flight or an uncompleted hold-down test resulting from a failure of equipment or of a system other than the one undergoing test. In a tactical operation (simulated or real) a missile failure either on the ground or in flight; a missile that fails to complete a programmed flight.
ADAPTER	Flange or extension of a vehicle stage or section providing a means of fitting another stage or section to it.
AEROBALLISTICS	Term derived from aerodynamics and ballistics, dealing primarily with the motion of bodies whose flight path is determined by applying the principle of both sciences to different portions of the path.
AEROTHERMODYNAMIC BORDER	Area above an altitude of about 100 miles where the atmosphere becomes so rarefied that there is no longer any significant heat-generating air friction on the skin of vehicles.
AIRFRAME	Assembled structural and aerodynamic components of an aircraft or missile.
ALBEDO	The ratio of light reflecting from an unpolished surface to the light falling upon it. Term is used in reference to light reflected from the moon or planets.
AMBIENT CONDITIONS	Environmental conditions such as pressure or temperature; naturally existing conditions.
ANTHROPOMORPHIC	Human-like; related to or designed for the human body.

APOLLO	NASA designation for follow-up manned space-flight program to Project Mercury manned orbital mission. Apollo spacecraft is to be suitable for manned earth-orbiting laboratory, manned circumlunar flight, manned lunar landing, and return.
ATLANTIC MISSILE RANGE (AMR)	A 5000- to 6000-mile instrumented range for testing ballistic and guided missiles located between Cape Canaveral, Florida, and a point beyond Ascension Auxiliary AFB, near the middle of the South Atlantic.
ATTITUDE	Orientation of an air vehicle as determined by the inclination of its axis to a frame of reference, usually the earth.
ATTITUDE JETS	Sometimes called steering jets, attitude-control jets or roll, pitch, and yaw jets; fixed or movable gas nozzles on a rocket, missile, or satellite operated continuously or intermittently to change attitude or position.
AXIS, AXES	Reference axes in the Apollo spacecraft are as follows:
X-axis	The X-axis is parallel to the nominal launch axis and is positive in the direction of initial flight.
Y-axis	The Y-axis is normal to the X-axis and is positive to the right of a crewman when the crewman is in his seat facing toward positive "X."
Z-axis	The Z-axis is normal to both the X- and Y-axes and is positive in the direction of the crewman's feet when he is in his seat.
BACKUP	Designed to immediately follow an earlier space system or a project to complement the latter or take advantage of new techniques and processes; a system that can replace a failed system.

BENCH MAINTENANCE EQUIPMENT	Equipment supporting component and subsystem testing; facilities capable of isolating, defining, and providing remedial action to malfunctions.
BIOMEDICINE	Combined discipline of biology and medicine for analysis of human tolerances to and protection against environmental variances.
BOILERPLATE	Simulated module for predevelopmental and developmental tests leading to the design of the spacecraft module.
BOOSTER ENGINE	An engine, especially a booster rocket, that adds thrust to the thrust of the sustainer engine, or provides propulsion for a special phase of flight.
BREADBOARD MODEL	An assembly of preliminary circuits and parts to prove the feasibility of a device, circuits, equipment, system or principle in rough or breadboard form without regard to the eventual over-all design or form of parts.
BRIDGE WIRE	The ignition resistor filament. The bridge wire heats the primary explosive to initiate the explosion.
CELESTIAL GUIDANCE	Mechanically or electrically recorded navigational tables, computers, and other instruments and devices that sight stars, calculate position, direct, and control the spacecraft.
CENTRIFUGE	A large motor-driven apparatus with a long rotating arm at the end of which human and animal subjects or equipment can be revolved at various speeds to simulate accelerations encountered in high-performance vehicles.
CHECKOUT	A sequence of operational and calibrational tests needed to determine the condition and status of a required operation or function.

COASTING FLIGHT	The flight of a rocket or other vehicle between burnout or thrust cutoff of one stage and ignition of another, or between final burnout and summit altitude or maximum range. Also the unpowered portion of an interplanetary flight.
COMMAND MODULE	Personnel and control vehicle in the Apollo spacecraft configuration containing command and communication facilities and crew provisions.
COMPATIBILITY	The quality that permits an item to function in harmony with other equipment and fulfill all design objectives.
CONFIGURATION	The physical nature of an item; the physical arrangement of components which comprise a spacecraft and its dimensions.
CONSOLE	Master instrument panel from which rocket and missile launchings and test are controlled; a group of controls, indicators, and similar electrical or mechanical equipment that is used to monitor readiness of and/or control specific functions such as missile checkout, countdown and launch operations.
COUNTDOWN	Series of numbered events and checks that take place from the start of rocket-launching operations until the rocket lifts off the launch stand.
CRYOGENIC FUEL	A rocket fuel that either in itself is kept at very low temperatures or combines with an oxidizer kept at very low temperatures.
CUTOFF	The shutting off of a liquid or solid-propellant combustion process of a rocket engine, causing a rapid drop toward zero thrust (intentional command action).
DEEP SPACE INSTRUMENTATION FACILITY (DSIF)	Communication equipment capable of contacting and tracking spacecraft beyond normal ranges. DSIF facilities are located at Woomera, Australia; Johannesburg, South Africa; and Goldstone, California

DEMONSTRATE	Denotes the occurrence of an action or an event during a test. The accomplishment of this type of objective requires a qualitative answer. The answer will be derived through the relation of this action or event to some other known information or occurrence. This category of objectives implies a minimum of system instrumentation and/or that information be obtained external to the test vehicle.
DESIGN VERIFICATION TEST	Basic development test used to determine the adequacy of the design over the anticipated operating conditions. A design verification test is always conducted by Engineering and on a breadboard level.
DETERMINE	Denotes the measuring of performance of any unit or system. This category implies the quantitative investigation of over-all operation, which includes, generally, instrumentation for measuring basic inputs and outputs of the unit or system. The information obtained should indicate to what extent the system is operating as designed. The instrumentation should allow performance deficiencies to be isolated to either the system or the system inputs.
DRAG	The resistance of a body to motion in a medium such as air.
DRY WEIGHT	Weight of a rocket vehicle without its fuel and usually without payload.
EARTH LANDING SUBSYSTEM (ELS)	Acceleration-decreasing equipment for return to the earth's surface after atmospheric reentry; may consist of a parachute system, a flexible aerodynamic glider configuration, or both.
ENGINEERING DEVELOPMENT PART	A part or unit to be employed in a breadboard design.
ENVIRONMENTAL CONTROL SUBSYSTEM (ECS)	The components controlling crew conditions in the spacecraft; governing factors of atmosphere, pressure, and temperature; and providing support for spacesuit conditions in event of cabin decompression or extra vehicular operations.

ESTABLISH	Denotes gathering information for the development of ground procedures and operating techniques. Objectives in this category are not necessarily dependent on analytic studies.
EVALUATE	Denotes the measuring of performance of any unit or system, as well as the performance and/or interaction of its sections or subsystems that are under investigation. The accomplishment of objectives of this type requires quantitative data on the performance of both the unit or system, and its sections or subsystems will be analyzed for their contribution toward performance of the unit or system. This category will provide the most detailed information of any of these categories.
FALLAWAY SECTION	Any section of a rocket vehicle that is cast off and falls away from the vehicle during flight, especially such a section that falls back to earth.
FIRST MOTION	First indication of motion of the missile or test vehicle from its launcher. Synonymous with "takeoff" for vertically launched missiles.
FLIGHT READINESS FIRINGS (FRF)	A missile system test consisting of the complete firing of the liquid-propellant engines of a rocket missile while it is restrained in its launching stand to verify the readiness of the missile for a flight test or mission.
FREE-FLIGHT TRAJECTORY (Free Fall Ellipse)	That part of a ballistic missile's trajectory that begins with thrust cutoff and ends at reentry.
FUEL CELL	A source of electrical power analogous to a common electrical cell with the reactants continually replenished from an external supply.
GAMMA RADIATION	Electromagnetic radiation having a high degree of penetration similar to X-rays originating from the nucleus.

GEMINI	NASA follow-up program to Mercury; a two-man spacecraft to demonstrate rendezvous and docking techniques, longer orbital flights (to 14 days), controlled reentry, and landing.
GIMBALED MOTOR	A rocket motor mounted on a gimbal, i. e., on a contrivance having two mutually perpendicular axes of rotation so as to correct pitching and yawing.
GODDARD SPACE FLIGHT CENTER (GSFC)	NASA research center at Greenbelt, Maryland, named for Robert H. Goddard, American rocket pioneer.
GOLDSTONE TRACKING FACILITY	A deep space instrumentation facility located at Army's Camp Irvin, Barstow, California, using a radiotelescope and operated for NASA by Jet Propulsion Laboratory (JPL).
GO NO-GO	A missile launch controlled at the end of the countdown as to permit an instantaneous change in decision on whether or not to launch.
GROUND OPERATIONAL SUPPORT SYSTEM (GOSS)	Network of tracking stations, fixed and mobile, air, ground, and seaborne to communicate with, track, and telemeter spacecraft and satellites.
GROUND SUPPORT EQUIPMENT (GSE)	All ground equipment that is part of the complete spacecraft system and that must be furnished to ensure its support. All implements or devices required to maintain the functional operational status of the spacecraft are included. In the Apollo program, bench maintenance equipment, combined system test unit, and prelaunch automatic checkout equipment comprise the GSE.
GUIDANCE	(1) The process of intelligent gathering and maneuvering required by a missile, probe, or space ship to reach a specified destination. (2) General term includes entire scheme: sensing devices, computers, and servo systems.

HEAT SHIELD	An ablative protective covering to ensure spacecraft and crew survival through the hypertemperatures of atmospheric reentry.
HEAT SINK	A device that absorbs heat energy.
HOT TEST	Propulsion system test conducted by actually firing the propellants. A hot test may be live, static, or conducted in a confined place.
INERTIAL GUIDANCE	An onboard guidance system for space and satellite vehicles where gyros, accelerometers, and possibly a gyro-stabilized platform satisfy guidance requirements without use of any ground-located components. The system is entirely automatic, following predetermined trajectory.
INFRARED LIGHT	Light in which the rays lie just below the red end of the visible spectrum.
INITIATOR	A primary explosive mixture used as a primer, detonator for caps which initiates the explosion of blasting propellant, bursting explosives at the desired moment.
INTERIM QUALIFIED	A term used to describe the status of a component or system scheduled for use in early flights wherein the basically essential qualification tests have been successfully completed as related to the specific flight objectives.
INVERTER	A converter to a-c power from a d-c source.
JET STEERING	The use of fixed or movable gas jets on a space weapon, ballistic missile, or sounding rocket for thrust vector control to steer it along a desired trajectory, during both propelled flight and after thrust cutoff.
KELVIN SCALE (K)	A temperature scale that used Centigrade degrees as gradients and absolute zero for zero. Zero Kelvin equals -460 F or -273 C.

LANGLEY RESEARCH CENTER	NASA installation in Hampton, Virginia, responsible for technical research in development and improvement in both atmospheric and space flight.
LAUNCH WINDOW	The allowable limits of launch time that will allow a spacecraft to achieve successful injection into programmed flight path.
LAUNCH ESCAPE SUBSYSTEM (LES)	The components for command module recovery in case of mission abort after launch and prior to orbit. The system consists of the launch escape motor, the launch escape tower, and the tower jettison motor.
LIQUID HYDROGEN	Liquid rocket fuel that develops a specific impulse, when oxidized by liquid oxygen, ranging between 317 and 364 seconds depending upon the mixture ratio.
LIQUID OXYGEN	Oxygen supercooled and kept under pressure so that its physical state is liquid. Used as an oxidizer in a liquid-fuel rocket.
LITTLE JOE (I, II)	A solid-rocket test vehicle developed by General Dynamics. I was used especially to test the Mercury capsule, and II will be used to test the Apollo spacecraft.
LUNAR EXCURSION MODULE	The two-man vehicle that will land on the moon after the Apollo spacecraft enters lunar orbit.
LUNAR ORBITAL RENDEZVOUS	The concept for manned lunar landing adopted by NASA wherein the lunar excursion module leaves the spacecraft, lands on the moon, and later returns to the orbiting spacecraft. The excursion module will be jettisoned as the spacecraft leaves lunar orbit.
MANNED SPACECRAFT CENTER (MSC)	NASA headquarters responsible for development and operation of manned space vehicles (Mercury, Gemini, Apollo), located in Houston, Texas.

MARSHALL SPACE FLIGHT CENTER (MSFC)	NASA operation responsible for design and development of space launch vehicles (Saturn, Advanced Saturn, Nova), located in Huntsville, Alabama.
MOCK-UP	A full-scale, three-dimensional representation of a complete spacecraft, individual module, and/or related equipment. Based on permanence and difficulty of alteration, mock-ups are graded as "soft," "semi-hard," and "hard."
MODULE	A combination of components, contained in one package or so arranged that together they are common to one mounting, which provides a complete function. (See command module, service module, lunar excursion module, etc.)
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)	Civilian agency, sponsored by the U. S. Government, with research and development jurisdiction in aeronautical and space activities except those activities peculiar to or primarily associated with the development of weapon systems, military operations, or the defense of the United States.
NAUTICAL MILE (NM)	A measure of distance equal to 6,076.103 feet or approximately 1.15 mile.
OBTAIN DATA	Denotes gathering engineering information that is to be measured to augment the general knowledge required in the development of the over-all spacecraft. This category may also be used for supplemental investigation, such as environmental studies, ground equipment studies, etc. The degree of instrumentation is not implied by this definition.
OPTICAL STAR TRACKER	A star tracker that locks onto the light of a particular celestial body. Distinguished from a radiometric star tracker. (See star tracker.)
OXIDIZER	A rocket propellant component, such as liquid oxygen, nitric acid, fluorine, and others, that supports the combustion of a fuel.

PAD	A permanent or semipermanent load-bearing surface constructed or designed as a base upon which a launcher can be placed. Short for launch pad.
PITCH	The movement about an axis that is at once perpendicular to the Apollo longitudinal axis and horizontal to the Y-axis of the spacecraft.
PRE-QUALIFIED	A pre-qualified part or component is one that has been scheduled as the one most likely to succeed in the qualification program and will be used in production runs as well as during developmental test or early flight test prior to qualification.
PRESSURIZED SUIT	A garment designed to provide pressure upon the body so that respiratory and circulatory functions may continue normally, or nearly so, under low-pressure conditions, such as occur at high altitudes or in space without benefit of a pressurized cabin.
PROGRAMMED ROLL	An automatically controlled roll of a ballistic missile or satellite, usually executed during its vertical ascent before pitch-over.
PROGRAMMED TURN	The turn of a ballistic missile from vertical motion, after lift-off, to a curved path approximating the desired powered flight trajectory prior to the initiation of guidance.
PROPELLANT	A liquid or solid substance burned in a rocket for the purpose of developing thrust.
PROTOTYPE	A model suitable for complete evaluation of mechanical and electrical form, design, and performance. It is in final mechanical and electrical form, employing approved parts, and completely representative of the final equipment.
QUALIFICATION OF PART, COMPONENT, OR SYSTEM	A part, component, or system is considered qualified by definition after it has successfully completed all of the prescribed tests associated with relevant control specifications.

READOUT	A radio transmitter transmitting data either instantaneously with computation of the data or by play of a magnetic tape on which the data have been recorded.
RECOVERY	The act of retrieving a portion of a launched missile or satellite that has survived reentry.
REENTRY	Return of a part of a space vehicle to the atmosphere after flight above the sensible atmosphere.
RELIABILITY	Reliability is the probability of performing without failure a specified function, under given conditions, for a specified period of time. It deals with the failure rates in time of specified items.
RETROROCKET	Relatively small rocket unit, usually solid propellant, installed on a rocket-propelled vehicle and fired in a direction opposite to the main motion to decelerate main unit.
ROLL	The movement of Apollo about its longitudinal (X) axis.
SATURN	The sun's sixth planet. A NASA rocket engine cluster in research and development expected to develop some 1,500,000 pounds of first-stage thrust. The Apollo launch vehicle.
SEPARATION	Moment when a full stage, half stage, a warhead, or a nose cone is separated from the remainder of the rocket vehicle; the moment when staging is accomplished.
SERVICE MODULE	Apollo module carrying propulsion equipment, fuel, reaction control systems, and communications power. It is used for thrust after booster separation, mid-course correction, lunar orbit, lunar orbit ejection, and earth return midcourse correction. It is jettisoned prior to reentry.
SERVICE PROPULSION SYSTEM	Engine and associated equipment providing thrust for service module functions. (See SERVICE MODULE.)

SOFT LANDING	Landing on the moon or other spatial body at such slow speed as to avoid damage of landing vehicle. Soft landings on moon are anticipated by use of retrorockets.
SOLAR FLARE	Solar phenomenon that gives rise to intense ultraviolet and corpuscular emission from the associated region of the sun. This affects the structure of the ionosphere and interferes with communications.
SOLID PROPELLANT	A propellant in solid condition including all the ingredients necessary for sustained chemical combustion, such as a compound of fuel and oxidizer, usually in plastic caked form. It burns on its exposed surface, generating hot exhaust gases to produce a reaction force.
SPACECRAFT	In the Apollo program, any component or combined components of the flight vehicle not part of the launch vehicle: launch escape subsystem, command module, service module, adapter, or any combination of these.
SPECIFIC IMPULSE	The thrust produced by a jet-reaction engine per unit weight of propellant burned per unit time, or per mass of working fluid passing through the engine in unit time. It is equal to thrust in pounds divided by weight flow rate in pounds per second.
STABILIZATION AND CONTROL SUBSYSTEM (SCS)	An Apollo monitor system linked to navigation and guidance system, display system, and reaction control subsystem indicating spacecraft attitude (roll, yaw, or pitch).
STAGE	In a rocket vehicle powered by successive units, one or other of the separate propulsion units.
STAGNATION POINT	The location on a surface in an airstream where the air flow is zero.

STAR TRACKER	A telescopic instrument on a missile or spacecraft that locks onto a celestial body and gives guidance to the missile or other object during flight.
STATIC TESTING	Testing of a missile or other device in a stationary or holddown position, to verify structural integrity, to determine the effects of limit loads, or to measure thrust.
SYSTEMS ENGINEERING	Process of applying science and technology to the study and planning of an over-all aerospace vehicle system, whereby relationships of various parts of the system and the use of various subsystems are fully planned and integrated prior to time hardware designs are committed.
TELEMETERING	The technique of recording space data by radioing an instrument reading from a rocket to a recording machine on the ground.
THEODOLITE	A sighting and measuring telescopic instrument that gives a reading on horizontal or vertical angles.
TRAJECTORY	The path described by a missile or a space vehicle.
TRANSFER ELLIPSE	Path followed by a body moving from one elliptical orbit to another.
ULLAGE	The amount of fluid by which a tank falls short of being full; the loss through evaporation, spilling, or consumption; the amount remaining that cannot be drained from an emptied tank or container.
UMBILICAL	Any one of several electrical or fluid lines connected between the ground support operation and an uprighted rocket missile or space vehicle before launch.
UNSYMMETRICAL DIMETHYLHYDRAZINE (UDMH)	Rocket fuel which with aerozine will power the Apollo spacecraft.

VECTOR STEERING	Vernacular for a steering method where one or more thrust chambers are gimbal mounted so that the direction of the thrust force (thrust vector) may be tilted in relation to the center of gravity of the missile to produce turning.
VELOCITY VECTOR	Combination of two ballistic missile trajectory values: the speed of the missile's center of gravity at a designated point on the trajectory and angle between local vertical and the direction of the speed.
WHITE SANDS MISSILE RANGE (WSMR)	A proving ground in New Mexico under the control of the Army Ordnance Missile Command; supports Apollo abort tests.
YAW	Lateral movement of the Apollo spacecraft along the Z-axis in line of flight.

REFERENCES

S&ID REPORTS

1. SID 61-460 — Contract Data Requirements - R & D Project Apollo
2. SID 62-50 — Apollo GSE Specification
3. SID 62-65 — Apollo Design Criteria Specifications
4. SID 62-99 — Monthly Weight and Balance Report
5. SID 62-109 — General Test Plan Research and Development for Project Apollo Spacecraft

   SID 62-109-1 Volume I General Test Plan Summary
   SID 62-109-2 Volume II Individual System Tests
   SID 62-109-3 Volume III Ground Qualification Tests
   SID 62-109-4 Volume IV Acceptance Test Plans
   SID 62-109-5 Volume V Multiple Systems Tests

6. SID 62-153 — Facilities Plan
7. SID 62-154 — Quality Control Program Plan
8. SID 62-243 — GSE End Items - Apollo
9. SID 62-244 — Spares, Systems and GSE Documentation - Apollo
10. SID 62-417 — GSE Planning and Requirements
11. SID 62-564 — GSE Requirements and Utilization for Apollo Development Program
12. SID 62-585 — Apollo Hardware Utilization List
13. SID 62-651 — Apollo Engineering Test Requirements on Test Fixture 2 and Airframe 001
14. SID 62-700-1, -2, -3 — Apollo Mission and Spacecraft General Performance Requirements and Specifications
15. SID 62-702 — Apollo Maintenance Plan

16. SID 62-931 — Requirement for Work and Resources, White Sands Missile Range

17. SID 62-972 — Apollo Test and Operations Mission Abort Test Program - Test Support Requirements

18. SID 62-975 — Apollo Test and Operations Environmental Proof Test Support Requirements

19. SID 62-1003 — Preliminary Specification NASA-Furnished Crew Equipment Interface Requirements Project Apollo

20. SID 62-1005 — GOSS Performance and Interface Specifications

21. SID 62-1014 — Definitions and Objectives Apollo GSE

22. SID 62-1145-1 — Apollo Integrated Systems GSE Concept Boilerplate No. 6

23. SID 62-1367 — Apollo Checkout and GSE Concept

24. SID 62-1408-1, -2, -3 — Apollo Measurement Requirements

25. SID 62-1450 — Apollo GSE Plan

26. SID 63-501 — Apollo Measurement Requirements, Airframe 001 and Test Fixture 2

27. SID 63-508 — Apollo C/M and S/M Measurement Requirements Airframe 008

28. SID 63-565 — Apollo Measurement Requirements, Boilerplate 15

29. SID 63-1040 — Apollo Simulation Plan

NASA REPORTS

Project Apollo Flight Mission Directive for Pad Abort I, NASA Project Apollo Working Paper 1049A, 24 January 1963.

Project Apollo Flight Mission Directive for Mission A-001, NASA Project Apollo Working Paper 1065, dated 31 January 1963

Project Apollo Flight Mission Directive for Mission A-101, NASA Project Apollo Working Paper 1085, dated 31 July 1963.

MQ 0501-008 Inspection Requirements for Materials and Processed Parts.

OTHER SPECIFICATIONS

NCP 200-2 Quality Assurance Provisions for Inspection Agencies

MIL-R-27542 Military Specification Reliability Program Requirements for Aerospace Systems, Subsystems and Equipment.

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